UNIT 1 DEFINITION AND SCOPE OF AQUACULTURE

Structure

1.1 INTRODUCTION

Aquaculture is a new name for what once we called 'fish culture'. Today, aquaculture includes not only culture of fishes but also a number of plants and animals that are cultivated in water. Aquaculture is conducted in all the three types of aquatic environments i.e., fresh water, brackish water and sea water. Aquaculture continues to increase in volume and value of output in many countries of the world, filling the gap between the supply and demand for fish and fishery products, improving nutrition, and contributing to the household economy, particularly in rural areas. There is immense scope for the betterment of mankind through aquaculture.

Objectives

After studying this Unit, you should be able to:

- define aquaculture,
- differentiate between aquaculture and agriculture,
- highlight the various forms and methods of aquaculture,
- appreciate the other usage of aquaculture besides producing nutritious food, and
- deliberate upon the future scope of aquaculture.

1.2 WHAT IS AQUACULTURE?

Aquaculture can be defined as **farming of aquatic fauna and flora for food, fun and fancy.**

The word **aquaculture** is relatively new to the English language. It is actually a new name to what once we called **fish culture**. In the beginning, it was only fishes which were cultivated in waters. Therefore, "fish culture" was a right terminology to express it. Today, not only fishes, but a host of plants and animals are cultivated in waters. Hence, instead of fish culture, **aquaculture** is considered as a more befitting nomenclature for the same.

1.3 AQUACULTURE AND AGRICULTURE

The word aquaculture rhymes well with agriculture. Semantically, also they sound alike i.e. what agriculture is on land, aquaculture is in water or more simply, aquaculture is underwater agriculture.

For the sake of definition, one many equate aquaculture with agriculture but in fact, both are quite different. Aquaculture deals with cultivation in a more complex ecosystem than agriculture. In aquaculture, one has to deal with three dimensional space i.e. surface, column and bottom for the different species or organisms that habitually grow at different levels. Thus, a water mass with a surface area of 1.0 hectare when stocked for cultivation in multi-species combination of various aquatic organisms, in effect, becomes a much larger area. The situation is not so in agriculture. Agriculture is product of plants and animals useful to human beings involving soil cultivation and the breeding and management of crops and lives to it. Tenure of production facilities and property rights to produce are as important to the success of aquaculture as land tenure is to agriculture.

1 hectare = 10,000 sq. metres

One acre-foot is a volume equivalent to one surface acre with a depth of one foot, equal to 325,850 gallons or approximately 2,718,000 pounds of water.

1.4 FORMS OF AQUACULTURE

Aquaculture is conducted in all the three types of aquatic environments

i) freshwater i.e. waters having salinity level of less than 0.5 parts per thousand (ppt),
ii) brackish water with salinity range of > 0.5 to 30 ppt and
iii) seawater with more than 30 ppt salinity. The species of flora and fauna inhabiting the three types of water bodies are accordingly called freshwater species, brackish water species and marine species.

Parts per Thousand is a concentration at which one unit is contained in a total of one thousand units. Sea water (35 ppt) is normally expressed as ppt.

Likewise, aquaculture pursuits in the three types of water are called

i) **freshwater aquaculture**,
ii) **brackishwater aquaculture** and
iii) **mariculture** or **sea farming**. Freshwater which is the most extensively used sector of aquaculture, is further divided into two segments

   a) cold waters of higher latitudes having temperature range of less than 18°C and
   b) warm waters of plains having temperature range of more than 18°C.

Aquaculture practices in these waters are, therefore, called coldwater aquaculture and warmwater aquaculture, respectively. Fresh water aquaculture is carried out either in fishponds, fish pens, fish cages or on limited scale, in rice paddies. Brackish water aquaculture is done mainly in fish ponds located in coastal areas. Marine culture employs either fish cages or substrates for molluscs and seaweeds such as stakes, ropes and rafts.

SAQ 1

What are the three types of aquaculture?

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1.5 SPECIES FOR AQUACULTURE

Compared to land animals, aquaculture is a much more varied activity mainly because there are many more species of aquatic organisms each with different characteristics for culture in freshwater, brackishwater and marine environments using different methods.

According to one report, there are about 500 aquatic species which are subjects of aquaculture today. These include 314 species of finfishes, 74 of crustaceans, 69 molluscs, 3 rotifers, 2 annelids, 1 echinoderm, 43 algae, 12 sponges, 9 amphibians, 4 reptiles and 2 mammals.

Some finfish and shellfish species dominate the international aquaculture scenario. They include rainbow trout, Atlantic salmon, Pacific salmon, Chinese carps including common carp, tilapias, penaeid shrimps and oysters.

Likewise, there are several species, which owing to their euryhaline nature, are suitable for culture in all the three types of aquatic environments (fresh, brackish and marine). These include red tilapia, milkfish, grey mullet etc.

Euryhaline: able to live in waters of a wide range of salinities, opposite of stenohaline.

A list of principal aquaculture species in Asia is given in Table 1.1 and illustrations of type specimens of major groups are given in Fig. 1.1 (a – n).

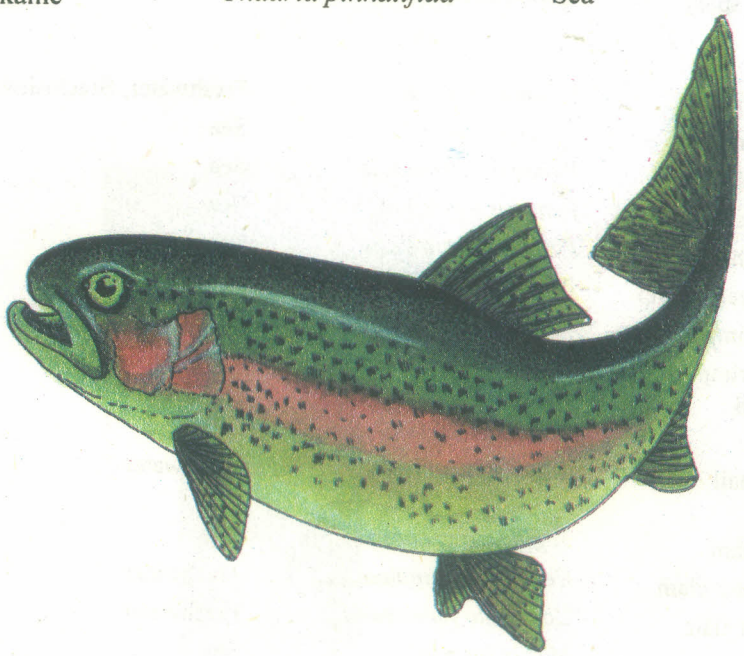
Table 1.1: Principal aquaculture species in Asia.

Common name	Scientific name	Environment of culture
FINFISHES		
• Ayu (Sweet fish)	*Plecoglossus altivelis*	Freshwater
Breams:		
• Black seabream (Porgy)	*Acanthopagrus schlegeli*	Brackishwater, Sea
• Chinese bream (Wuchang fish)	*Megalobrama amblycephalus*	Freshwater
• Red seabream (Porgy)	*Pagrus major (Chrysophrys major)*	Sea
Carps:		
Chinese carps		
• Bighead carp	*Aristichthys nobilis*	Freshwater
• Black carp	*Mylopharyngodon piceus*	Freshwater
• Common carp	*Cyprinus carpio*	Freshwater
• Crucian carp	*Carassius carassius*	Freshwater
• Gold fish	*Carassius auratus*	Freshwater
• Grass carp	*Ctenopharyngodon idellus*	Freshwater
• Silver carp	*Hypophthalmichthys molitrix*	Freshwater
Indian major carps		
• Catla	*Catla catla*	Freshwater
• Mrigal	*Cirrhina mrigala*	Freshwater
• Rohu	*Labeo rohita*	Freshwater
Other carps		
• Calbasu	*Labeo calbasu*	Freshwater
• Bata	*Labeo bata*	Freshwater
• Reba	*Cirrhina reba*	Freshwater
• White carp (kaveri carp)	*Cirrhinus cirrhosus*	Freshwater
• Fringe-lipped carp	*Labeo fimbriatus*	Freshwater

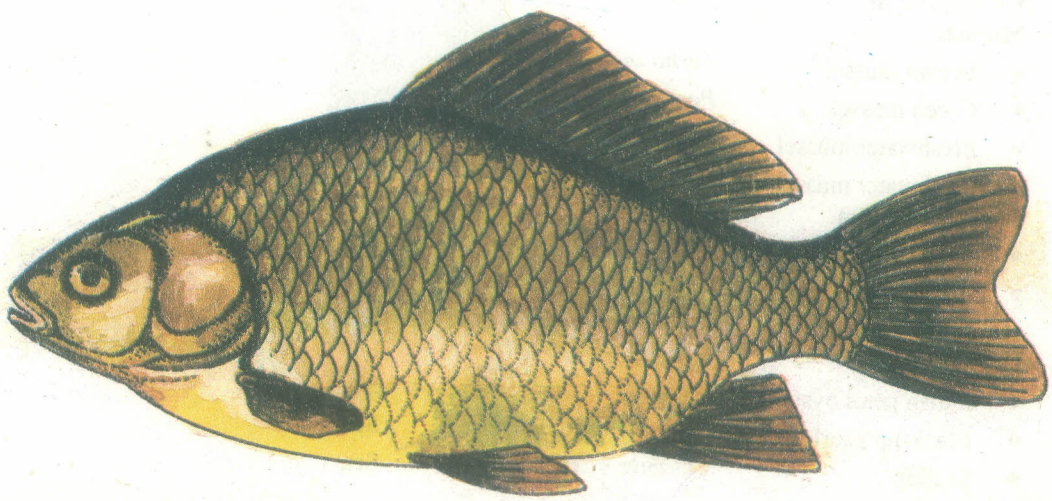
• Kursa	*Labeo gonius*	Freshwater
• Jelawat	*Leptobarbus hoevenii*	Freshwater
• Tawes (Puntius carp)	*Puntius gonionotus*	Freshwater
Catfishes:		
• River catfish	*Pangasius sutchi*	Freshwater
• Walking catfish	*Clarias spp.*	Freshwater
• Japanese catfish	*Parasilurus asotus*	Freshwater
Eels:		
• European eel	*Anguilla anguilla*	Freshwater, Brackishwater, Sea
• Japanese eel	*Anguilla japonica*	Freshwater
• Featherback	*Notopterus chitala*	Freshwater
• Grey mullet	*Mugil cephalus*	Freshwater
Groupers:		
• Estuarine grouper	*Epinephelus tauvina*	Freshwater, Brackishwater, Sea
• Malabar grouper	*Epinephelus malabaricus*	Sea
• Polkadot grouper	*Chromileptis altivelis*	Sea
• Red grouper	*Plectopomus maculatus*	Sea
• Tiger grouper	*Epinephelus microdon*	Sea
• Horse mackerel	*Trachurus japonicus*	Sea
• Japanese flounder	*Paralichlthys olivaceus*	Sea
Mahseers:		
• Milk fish	*Chanos chanos*	Freshwater, Brackishwater, Sea
• Mud skipper	*Boliophthalmus chinensis*	Sea
• Pearl spot	*Etroplus suratensis*	Brackishwater
• Pond loach	*Misgurnus anguillaris*	Freshwater
• Puffer (Tiger puffer)	*Sphaeroiders rubripes*	Sea
• Rabbit fish	*Siganus fuscessens*	Sea
	Siganus canaliculatus	Sea
• Rock fish	*Sebastiscus marmoratus*	Sea
Salmonids:		
• Atlantic salmon	*Salmo spp.*	Sea
• Pacific salmon	*Oncorhynchus spp.*	Sea
• Seabass (cockup)	*Lates calcarifer*	Brackishwater, Sea
• Silver sillago	*Sillago sihama*	Brackishwater, Sea
Snakeheads:		
• Striped snakehead	*Channa striatus*	Freshwater
• Snakehead	*Channa maculata*	Freshwater
• Snake-skin gourami	*Trichogaster pectoralis*	Freshwater
Snappers:		
• Blackspot snapper	*Lutijanus fulviflamma*	Sea
• Emperor red snapper	*Lutijanus sebae*	Sea
• Golden snapper	*Lutijanus johni*	Sea
• Malabar blood snapper	*Lutijanus malabaricus*	Sea
• River snapper	*Lutijanus argentimaculatus*	Sea
Tilapias:		
• Blue tilapia	*Oreochromis aureus*	Freshwater
• Mozambique tilapia	*Oreochromis mossambicus*	Freshwater
• Nile tilapia	*Oreochromis niloticus*	Freshwater
• Red tilapia	*Oreochromis hybrids*	Freshwater, Brackishwater, Sea
• Red belly tilapia	*Tilapia zillii*	Freshwater
Trouts:		
• Brown trout	*Salmo trutta fario*	Freshwater
• Rainbow trout	*Salmo gairdnerii*	Freshwater

Tunas:		
• Bluefin tuna	*Thunnus thynnus*	Sea
• Yellow tail	*Seriola quinquiradiata*	Sea
CRUSTACEANS		
Freshwater prawns:		
• Giant prawn	*Macrobrachium rosenbergii*	Freshwater
• River prawn	*Macrobrachium malcalmsonii*	Freshwater
Lobsters:		
• Long-legged spiny lobster	*Panulirus longipes*	Sea
• Mud spiny lobster	*Panulirus polyphagus*	Sea
• Ornate spiny lobster	*Panulirus ornatus*	Sea
• Painted spiny lobster	*Panulirus versicolor*	Sea
• Pronghorn spiny lobster	*Panulirus penicillatus*	Sea
• Scalloped spiny lobster	*Panulirus homarus*	Sea
• Japanese spiny lobster	*Panulirus japonicus*	Sea
Shrimps:		
• Tiger shrimp	*Penaeus monodon*	Freshwater, Brackishwater, Sea
• White shrimp	*Penaeus indicus*	Sea
• Banana shrimp	*Penaeus merguensis*	Sea
• Kuruma shrimp	*Penaeus japonicus*	Sea
• Redtail shrimp	*Penaeus penicillatus*	Sea
• Green tiger shrimp	*Penaeus semisulcatus*	Sea
• Sand shrimp	*Metapenaeus ensis*	Brackishwater, Sea
• Brine shrimp	*Artemia salina*	Sea
MOLLUSCS		
• Abalone	*Haliotis diversicolor*	Sea
• Apple snail	*Ampullarius insularum*	Freshwater
Clams:		
• Blood clam	*Tegillarca granosa*	Sea
• Freshwater clam	*Corbicula fluminea*	Freshwater
• Formosa clam	*Corbicula formosana*	Freshwater
• Hard clam	*Metrix lusoria*	Sea
• Purple clam	*Soletellina diphos*	Sea
• Giant snail	*Achatina fulica*	Freshwater
Mussels:		
• Brown mussel	*Perna indica*	Sea
• Green mussel	*Perna viridis*	Sea
• Freshwater mussel	*Lamillidens marginalis*	Freshwater
• Freshwater mussel	*Lamillidens corianus*	Freshwater
Oysters (Edible)		
• Pacific cupped oyster	*Crassostrea gigas*	Sea
• Portuguese oyster	*Crassostrea angulata*	Sea
• Edible oyster	*Crassostrea madrasensis*	Sea
Oysters (Pearl)		
• Indian pearl oyster	*Pinctada fucata*	Sea
• Black-lip pearl oyster	*Pinctada margaritifera*	Sea
• Scallop	*Chlamys nobilis*	Sea

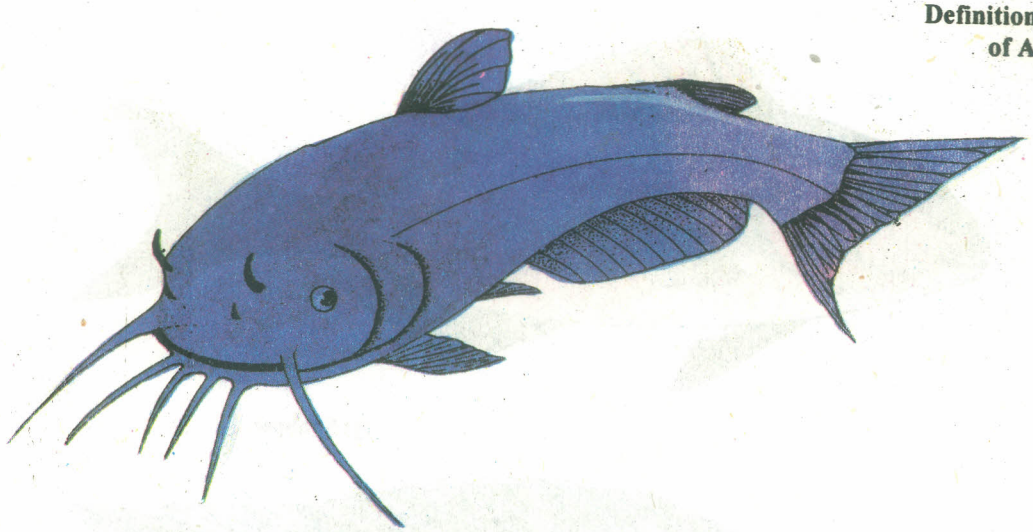
AMPHIBIANS		
• Bull frog	*Rana catasbiana*	Freshwater
• Tiger frog	*Rana tigrina*	Freshwater
REPTILES		
• Soft-shelled turtle	*Trionyx sinensis*	Freshwater
• Siamese crocodile	*Crocodilus siamensis*	Freshwater
• Estuarine crocodile	*Crocodilus porocus*	Freshwater
ECHINODERMS		
• Sea cucumber	*Holothuria scabra*	Sea
AQUA-PLANTS		
• Makhana	*Euryale ferox*	Freshwater
• Singhara (water chestnut)	*Trapa spp.*	Freshwater
• Agarophytes	*Gracilaria spp.*	Brackishwater, Sea
• Green laver	*Monostroma nitidum*	Sea
• Kombu	*Laminaria japonica*	Sea
• Nori	*Porphyra spp.*	Sea
• Wakame	*Undaria pinnatifida*	Sea



(a) Finfish

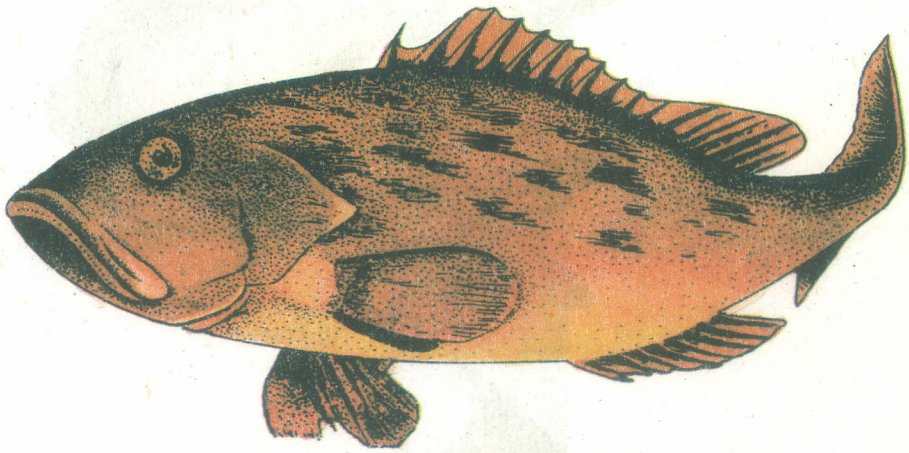


(b) Carp

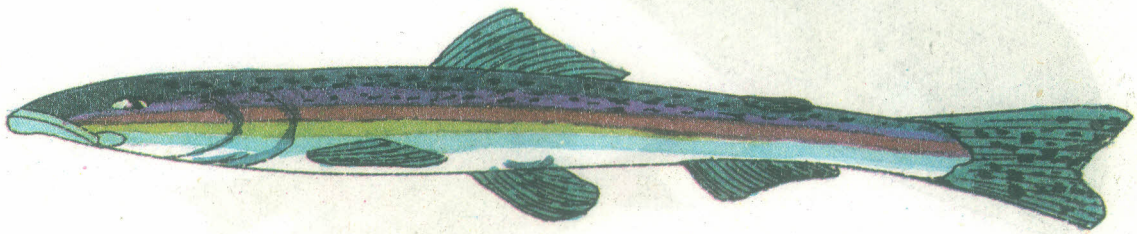


(c) Catfish

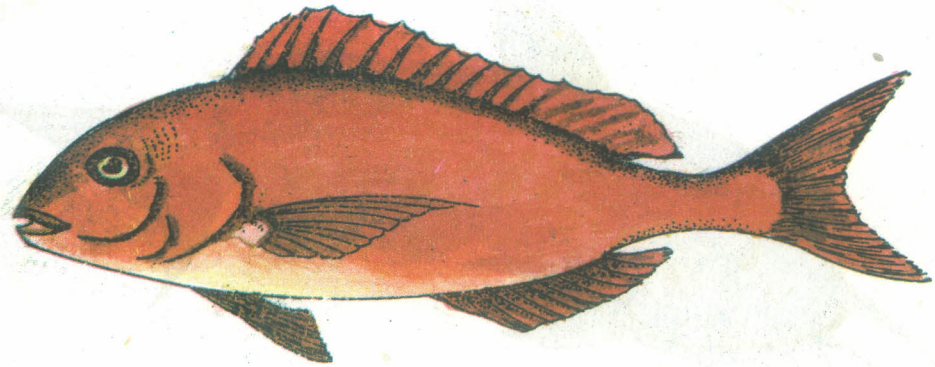
(d) Eel



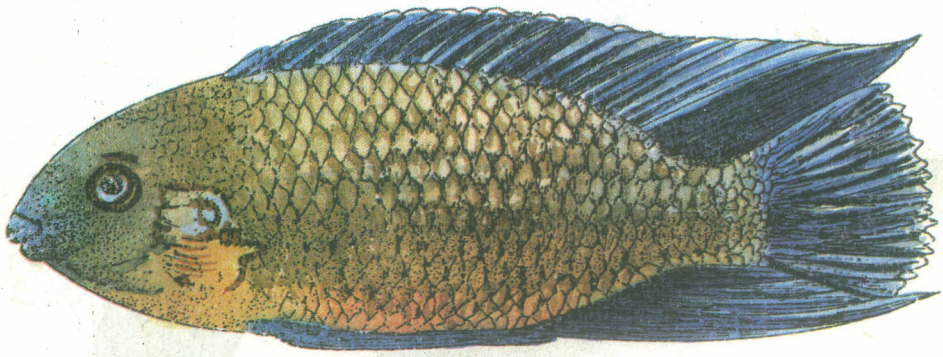
(e) Grouper



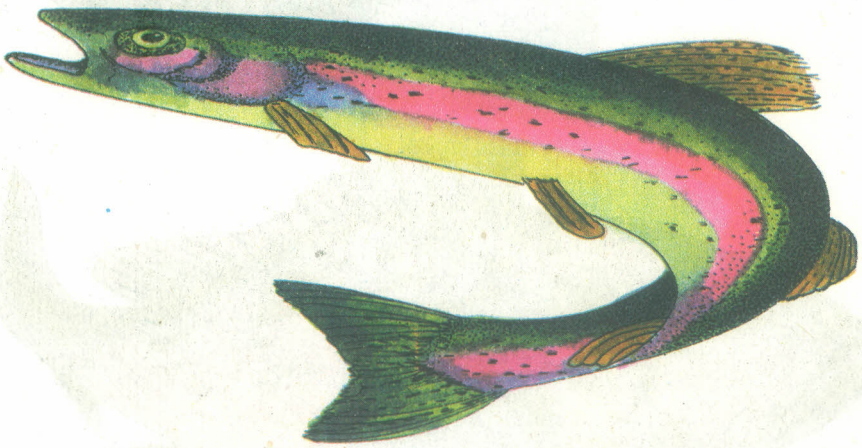
(f) Salmonid



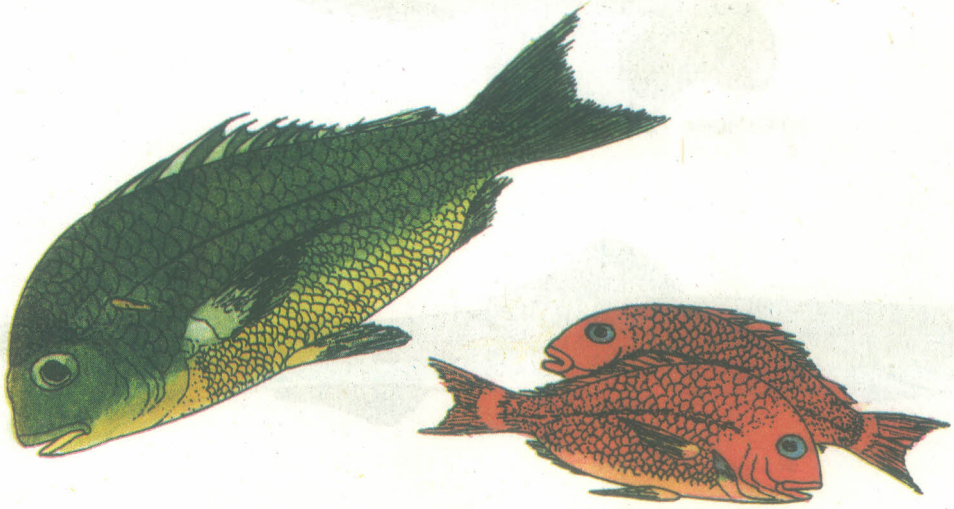
(g) Snapper



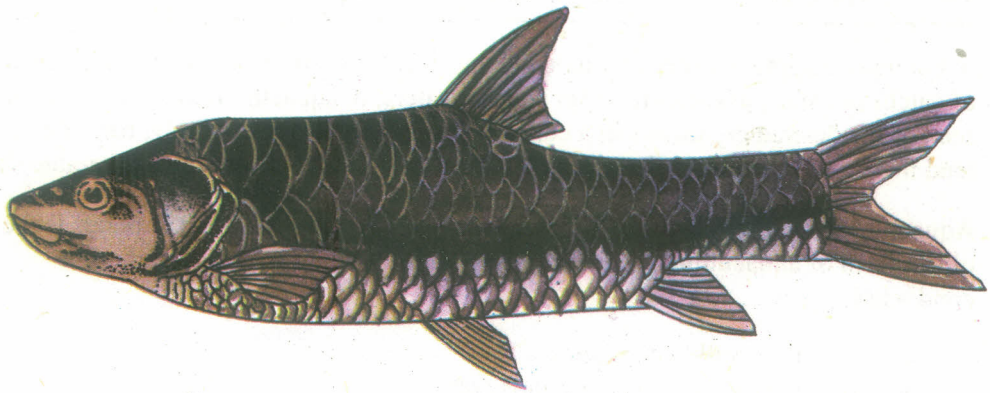
(h) Tilapia



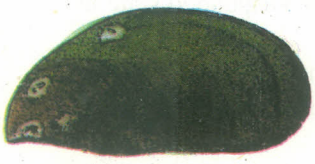
(i) Trout



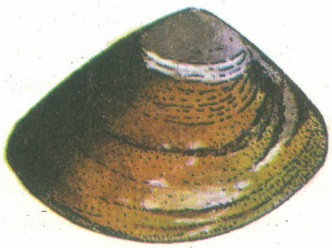
(j) Sea-bream



(k) Mahseer



(l) Green Mussel



(m) Fresh water clam

(n) Spiny lobster

Fig. 1.1 a – n: Principal aquaculture species in Asia.

SAQ 2

a) Name two Indian carps as principal aquaculture species.

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b) Name two lobsters as principal aquaculture species.

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1.6 METHODS OF AQUACULTURE

In contrast to capture fisheries where one has only to think about an effective device of catching fishes, prawns etc. from natural waters, in aquaculture one has to stock the seed of the desired organisms in a controlled unit area of a water body, feed them, tend them and then obtain their harvest after the organisms attain the marketable size.

Aquaculture is practised through various methods. Culture of fishes in ponds is the oldest form of aquaculture. There are three ways in which pond aquaculture is conducted

i) aquaculture in still water ponds
ii) aquaculture in running water ponds and
iii) aquaculture in ponds having recirculating water.

Aquaculture in pens is a method in which aquatic organisms are grown in specially erected enclosures in open water bodies. Aquaculture in cages, likewise, is a device in which cultivable organisms are raised in enclosures installed in suspended state in flowing or stagnant waters.
Integrated aquaculture is an innovative approach in which aquatic organisms are grown in combination with agriculture or livestock raising in such a way that the by-product of each system mutually benefits each other.

Molluscs such as oysters and mussels are cultured on suspended ropes or wires hung from rafts floating at the surface of water. The seed i.e. bivalve larvae attached on shells are strung on ropes and hung in water for further growth. Additional floats are added to the raft as the growth proceeds and total weight of the growing biomass increases.

Seaweeds are grown using different types of planting material such as vegetative cuttings, natural seeds, and hatchery-reared seeds. The methods of culture include bottom culture, rope culture, pond culture either in monoculture or polyculture with milkfish, shrimps and crabs.

You will learn about these methods and practices of aquaculture in greater detail in Unit 2 of Block 1 and further in Block 4 of this course.

1.7 OPERATIONAL SCALES OF AQUACULTURE

Aquaculture practices progress from minimal to maximal inputs of external energy, ecosystem manipulation and management. Accordingly, depending on the intensity of operation, aquaculture practices are classified into three operational scales viz.

i) Extensive aquaculture
ii) Semi-intensive aquaculture
iii) Intensive aquaculture

Extensive systems use low stocking densities (5,000-10,000 shrimp post larvae).Extensive aquaculture involves a low degree of control over the environment, nutrition, predator etc. Water change is effected through tidal means, i.e., new water is let in only during high tide and pond can be drained only at low tide. Although, large size ponds are used but little care is taken with regard to its improvement. Natural food organisms, often generated within the culture unit itself, sustain the system. The yield under this system is modest, hardly more than the natural production.

Intensive culture uses very high densities of culture organisms (200,000 – 300,000 shrimp post larvae). Intensive aquaculture, on the other hand, involves high degree of control over the system and high initial costs, a high level of technology and high production levels. Small pond compartments of upto one hectare in size are used.

The stock is an interbreeding sub-population of a species, reproductively isolated to some extent from other populations. Used as a unit for fishery management, however 'stock' refers to a specific population or group of populations of one or more species.

There is a maximum output of product in a minimum of space and water. Virtually, all nutrition for the cultured organisms comes from the use of high quality nutritionally balanced feed. Water quality monitoring, water replacement and aeration is done on daily basis by the use of pumps and aerators.

Semi-intensive aquaculture is a mix of the extensive and intensive aquaculture. Stocking rates are moderately used under this system (50,000 – 100,000 shrimps post larvae).

Semi-intensive and intensive culture systems are more labour – intensive and are costlier to set up and operate. They also carry higher risks of mortalities from disease and poor management. Production and hence financial returns are much more attractive than those from extensive culture. A summary of the comparative features among three main types of culture systems is shown in Table 1.2.

Table 1.2: Summary of comparative features among the three main culture systems.

Parameter	Extensive	Semi-Intensive	Intensive
Species Used	Monoculture or Polyculture	Monoculture	Monoculture
Stocking Rate	Moderate	Higher than extensive culture	Maximum
Engineering Design and Layout	May or may not be well laid-out	With provision for effective water management	Very well engineered system with pumps and aerators to control water quality and quantity
	Very big ponds	Manageable-sized units (up to 2 ha each)	Small ponds, usually 0.5 – 1 ha each
	Ponds may or may not be fully cleaned	Fully cleaned ponds	Fully cleaned ponds
Fertilizer	Used to enhance natural productivity	Used regularly with lime	Not used
Pesticides	Not used	Used regularly for prophylaxis	Used regularly for prophylaxis
Food and Feeding Regimen	None	Regular feeding of high quality feeds	Full feeding of high-quality feeds
		Depending on stocking density used, formulated feeds may be used partially or totally	
Cropping Frequency (crops/year)	2	2.5	2.5
Quality of Product	Good quality	Good quality	Good quality
	Culture species dominant but extraneous species may occur	Confined to culture species	Confined to culture species
	Variable sizes	Uniform sizes	Uniform sizes

1.8 SCOPE OF AQUACULTURE

Future holds immense scope for the betterment of mankind through aquaculture in several ways:

1.8.1 Best Option to Capture Fisheries

The myth that seas and oceans are inexhaustible sources of fishes, prawns etc. has already been proved wrong. Major traditional fishing grounds in a number of developing countries has started showing declining fish catches. Aquaculture, in such a situation, is seen as the best option for meeting the food requirement of growing masses.

1.8.2 Meeting the Requirement of Proteinous Diet

In many countries, specially in the developing world, fish and other aquacrops will serve as the main source of cheap protein to combat malnutrition and under nutrition. This is because fishes possess essential amino acids that are often lacking in cereal protein substitutes. Moreover, fishes are more efficient in converting food into body tissue than poultry or livestock.

1.8.3 Employment and Income Generation

With its growing activities aquaculture is likely to employ a large number of people either directly in the culture activity or indirectly as employees in related or ancillary industries such as seed suppliers, feed suppliers, cold storage etc.

Aquaculture will also serve as an ideal alternative livelihood for fishing communities, more particularly in developing countries where the source of income of fisherfolks has been adversely affected by the over-exploitation of traditional fishing grounds.

Aquaculture will also come to be viewed as an important alternative for those countries whose traditional fishing grounds have been severely reduced by the imposition of the 200 mile Exclusive Economic Zone (EEZ). With the export of high-value species like penaeid shrimps, oysters, seaweeds, etc., aquaculture will serve as an excellent source of earning foreign exchange.

A maritime zone adjacent to the territorial sea that may not extend beyond 200 nautical miles from the baseline from which the breadth of the territorial sea is measured is called Exclusive Economic Zone (EEZ). Within EEZ, the coastal state has sovereign rights for the purpose of exploring, exploiting, conserving and managing natural resources.

Nautical mile is a maritime measure of distance, originally equal to one minute of latitude at the equator (1 nautical mile is equivalent to 1.85 km)

1.8.4 As an Effective Tool for Recycling Municipal Sewage

Increasing population pressure has already started weighing heavy on water supply. During the ensuing decades, the situation is going to worsen further. In such a situation, we shall be hardly left with any option than to learn to use the used water through appropriate treatment. In big cities particularly, generation of sewage is enormous. Of late, it is being increasingly realized that municipal sewage is just not a pollutant but also a nutrient resource. Recycling of municipal sewage through aquaculture is an effective method of retrieving those nutrients.

1.8.5 Resource Enhancement of Open Waters

The resource potential i.e. aquatic flora and fauna of open waters are getting depleted alarmingly due to factors like over-exploitation, environmental degradation etc. Resource enhancement in such waters is possible only by stocking them with hatchery produced seeds of desired aquatic organisms and providing them with appropriate artificial shelters enabling the organisms to guard themselves against natural enemies so that they could reach a size where predation and juvenile mortality are much reduced. The technique, called aqua ranching, holds immense promise for future.

1.8.6 Other Uses of Aquaculture

Aquaculture is not limited to the production of species. Crustaceans and small fishes are often grown as bait for sport and/or commercial fisheries. Ornamental species constitute one of the highest value aquaculture industries.

Some species are grown as food for other food fishes while others are raised for use in laboratory as experimental animals.
Some fishes like grass carp is grown for controlling infestation of noxious aquatic weeds while some other fishes (larvicidal ones) e.g. *Gambusia* and *Poecillia* for mosquito control.

Oysters and freshwater mussels are grown to produce cultured pearls and crocodiles for leather, aqua-mammals (dolphins, whales, seals etc.) for fun and entertainment.

Several algal species are cultured for extraction of chemicals. Seaweeds are important sources of agar and iodine. Some species of red algae are valuable source of carrageenan, an important industrial compound used for improving the quality of a number of products.

Carrageenan is obtained by extraction with water of certain species of the class Rhodophyceae (red sea weed). It is a hydrocolloid consisting mainly of the potassium, sodium, magnesium and calcium sulfate esters of galactose.

SAQ 3

State whether the following statements are true or false.

i) Pen culture is the oldest form of aquaculture.
ii) Fishes possess essential amino acids that are often lacking in cereal protein substitutes.
iii) For aquaculture of sessile invertebrates like oysters and mussels, bottom culture is the most popular method.
iv) Grass carp is grown for mosquito control.

1.9 SUMMARY

In this unit you have learnt that

- For the sake of definition, one may equate aquaculture with agriculture but in practice aquaculture deals with cultivation in a much more complex ecosystem.
- There are about 500 aquatic species which are cultivated in three types of aquatic environments i.e. freshwater, brackishwater and sea water.
- Aquaculture is practised in various forms *viz.* pond culture, pen culture, cage culture, integrated aquaculture, rope culture, raft culture and so on.
- In contrast to capture fisheries where one has only to think about an effective device of catching fishes from natural waters; in aquaculture, one has to stock the seed of the desired organisms in a controlled unit area of water body, feed them, tend them and then obtain harvest after attainment of marketable size.
- Aquaculture holds immense scope for the betterment of mankind in several ways *viz.* as best option to catch fish, meeting requirement of proteinous diet, source of employment and income generation as also earning foreign exchange, as a biotechnological tool for recycling of municipal sewage and resource enhancement of open waters.
- Besides production of food species, aquaculture is also used for culture of bait fishes, live food for aqua hatcheries, herbivorous fishes for weed control, larvicidal fishes for mosquito control, oysters and mussels for pearl culture, crocodiles for leather, aqua-mammals for fun and algae for extraction of chemicals and so on.

1.10 TERMINAL QUESTIONS

1. Define aquaculture. How do you compare agriculture with aquaculture?

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2. Discuss the scope of aquaculture for future.

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3. Besides the production of food species, what are the other uses of aquaculture?

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1.11 ANSWERS

Self-assessment Questions

1. i) Freshwater aquaculture, ii) Brackishwater aquaculture, iii) Mariculture
2. a) Common carp and Goldfish, b) Japanese spiny lobsters and mud spiny lobster
3. i) F, ii) T, iii) F, iv) F

Terminal Questions

1. Aquaculture can be defined as farming of aquatic fauna and flora for food, fun and fancy. Aquaculture deals with cultivation in a more complex ecosystem than agriculture. Aquaculture is underwater agriculture.
2. Aquaculture has immense scope for the betterment of mankind in several ways:
   a) meeting the requirement of proteinous diet
   b) employment and income generation
   c) source of earning foreign exchange
   d) effective tool for recycling municipal sewage
3. Aquaculture is not limited to the production of food. Some fishes are grown for controlling infestation of aquatic weeds while other fishes are used for mosquito control. Several algal species are cultured for extraction of chemicals. Seaweeds are important sources of agar and iodine.